NAME: Key

MIDTERM EXAM
Review

Unit 1 → Introduction, Chemistry, and Matter

Vocabulary

chemistry	matter	mass
weight	scientific method	qualitative data
quantitative data	hypothesis	experiment
independent variable	dependent variable	control
conclusion	model	theory
scientific law	pure research	applied research
technology	substance	physical property
intensive property	chemical property	states of matter
solid	liquid	gas
vapor	physical change	chemical change
law of conservation of mass	mixture	heterogeneous mixture
homogeneous mixture	solution	filtration
distillation	crystallization	chromatography
element	periodic table	compound
law of definite proportions	percent by mass	law of multiple proportions
extensive property		

Objectives

- **Define** chemistry and matter.
- **Compare** and **contrast** mass and weight.
- **Explain** why chemists are interested in a submicroscopic description of matter.
- **Identify** the common steps of scientific methods.
- **Compare** and **contrast** types of data.
- **Compare** and **contrast** types of variables.
- **Describe** the difference between a theory and a scientific law.
- **Compare** and **contrast** pure research, applied research, and technology.
- **Apply** knowledge of laboratory safety.
- **Identify** the characteristics of a substance.
- **Distinguish** between physical and chemical properties.
- **Differentiate** among the physical states of matter.
- **Define** physical change and list several common physical changes.
- **Define** chemical change and list several indications that a chemical change has taken place.
- **Apply** the law of conservation of mass to chemical reactions.
- **Contrast** mixtures and substances.
- **Classify** mixtures as homogeneous or heterogeneous.
- **List** and **describe** several techniques used to separate mixtures.
- **Distinguish** between elements and compounds.
- **Describe** the organization of elements on the periodic table.
- **Explain** how all compounds obey the law of definite and multiple proportions.

NAME:

Short Answer and Problem-Solving

1. Classify the following materials listed below. Write "E" for element, "C" for compound, "S" for solution, or "H" for heterogeneous mixture.

Solution = homogeneous mixture

propane gas	C
chocolate chip cookie dough	H
lithium metal	E
salt water	S

2. Distinguish between the types of properties in the example below. Circle your answers.

only chemical if color changes

color	**chemical**	**physical**
reactivity	**chemical**	**physical**
solubility	**chemical**	**physical**
combustibility	**chemical**	**physical**
length	**chemical**	**physical**

3. Determine the percent composition of oxygen in the compound $Fe(OH)_2$.

$$\frac{\text{mass of oxygen}}{\text{mass of compound}} \qquad \frac{2(16g)}{1(55.8g)+2(16g)+2(1g)} \times 100 = 36\,\%$$

Unit 2 → Data Analysis

Vocabulary

base unit	second	meter
kilogram	derived unit	liter
density	Kelvin	scientific notation
conversion factor	dimensional analysis	accuracy
precision	percent error	significant figure
graph		

Objectives

- **Define** SI base units for time, length, mass, and temperature.
- **Explain** how adding a prefix changes a unit.
- **Compare** the derived units for volume and density.
- **Express** numbers in scientific notation.
- **Use** dimensional analysis to **convert** between units.
- **Define** and **compare** accuracy and precision.
- **Use** significant figures and rounding to reflect the certainty of data.
- **Use** percent error to **describe** the accuracy of experimental data.
- **Create** graphs to reveal patterns in data.
- **Interpret** graphs.

NAME:

Short Answer and Problem-Solving

4. Perform the following conversions using dimensional analysis.

1 kg = 2.2 lbs	**1 L = 34 oz**	**3 ft = 1 yd**	**1 kg = 1000 g**
1 L = 1000 ml	**1000 mg = 1 g**	**5280 ft = 1 mile**	**1 m = 1.13 yd**

How many milligrams are equal to 3.0 kg?

$$3.0\ kg\left(\frac{1000g}{1kg}\right)\left(\frac{1000mg}{1g}\right) = 3\times10^{6}\ mg \text{ or } 3{,}000{,}000\ mg$$

There are about 25 miles between Upper Dublin and Philadelphia. How many meters are in between the two?

$$25\ mi\left(\frac{5280\ ft}{1\ mi}\right)\left(\frac{1\ yd}{3\ ft}\right)\left(\frac{1\ m}{1.13\ yd}\right) = 38{,}938.05310\ m$$

39,000 m w/ SF

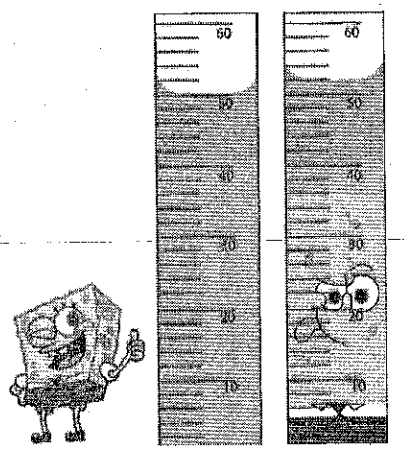
The density of titanium is 4.5 g/ml. Convert this density to lbs/oz.

$$\frac{4.5\ g}{mL}\left(\frac{1\ kg}{1000\ g}\right)\left(\frac{2.2\ lb}{1\ kg}\right)\left(\frac{1000\ mL}{1\ L}\right)\left(\frac{1\ L}{34\ oz}\right) = 0.29\ lbs/oz$$

5. Calculate the density of Sponge Bob using the diagram (measuring in milliliters) below. Assume he has a mass of 21 g.

$D = \frac{m}{V}$ $\quad \frac{21\ g}{2\ mL} = 10.5\ g/mL$

or 11 g/mL w/ SF



6. A student measured the temperature of boiling water and got a measurement reading of 97.5 °C. If the actual boiling point of water is 100 °C, what is the student's percent error?

$$\frac{|100 - 97.5|}{100.} \times 100 = 2.5\ \%$$

NAME:

Unit 3 → Atomic Structure and Nuclear Chemistry

Vocabulary

Dalton's atomic theory	atom	cathode ray
electron	nucleus	proton
neutron	atomic number	isotope
mass number	atomic mass unit (amu)	atomic mass
nuclear reaction	radioactivity	radiation
radioactive decay	alpha radiation	alpha particle
nuclear equation	beta radiation	beta particle
gamma ray	radioisotope	x ray
strong nuclear force	band of stability	positron emission
positron	electron capture	radioactive decay series
nucleon	transmutation	induced transmutation
transuranium element	half-life	radiochemical dating
mass defect	nuclear fission	critical mass
breeder reactor	nuclear fusion	thermonuclear reaction
ionizing radiation	radiotracer	

Objectives

- **Compare** and **contrast** the atomic models of Democritus and Dalton.
- **Define** an atom.
- **Distinguish** between the subatomic particles in terms of relative charge and mass.
- **Describe** the structure of the nuclear atom, including the locations of the subatomic particles.
- **Explain** the role of atomic number in determining the identity of an atom.
- **Define** an isotope and **explain** why atomic masses are not whole numbers.
- **Calculate** the number of electrons, protons, and neutrons in an atom given its mass number and atomic number.
- **Explain** the relationship between unstable nuclei and radioactive decay.
- **Characterize** alpha, beta, and gamma radiation in terms of mass and charge.

Short Answer and Problem-Solving

7. Complete the following table.

Atomic #	Mass #	# Protons	# Neutrons	# Electrons
8	16	8	8	8
28	59	28	31	28
20	41	20	21	20

NAME:

8. Calculate the atomic mass of magnesium given the information below.

Isotope	Mass	% Abundance
^{24}Mg	23.98504	78.70
^{25}Mg	24.98584	10.13
^{26}Mg	25.98259	11.17

18.87622648
2.531065592
+ 2.902255303
24.30955 amu

9. Write an equation for the emission of an alpha particle from Ra-226.

$$^{226}_{88}Ra \longrightarrow {}^{4}_{2}He + {}^{222}_{86}Rn$$

10. Determine whether carbon-14 is stable or unstable. If it is an unstable isotope, write the nuclear equation for its most likely decay reaction.

C-14 6 protons : 8 neutrons → unstable need 1:1 ratio Beta decay

$$^{14}_{6}C \rightarrow {}^{0}_{-1}\beta + {}^{14}_{7}N$$

11. What is the half-life of a substance that decays from 12.0 g to 3.0 g in 18 seconds?

$\frac{f}{i} = \frac{1}{2}^n$ $\frac{3}{12} = \frac{1}{2}^n$ $n = 2$ $TE = 18$ Halflife ✓

$\frac{18}{2} = 9$ sec $n = \frac{TE}{t_{1/2}}$ or $t_{1/2} = \frac{TE}{n}$

Unit 4 → Electrons in Atoms

Vocabulary

electromagnetic radiation	wavelength	frequency
amplitude	electromagnetic spectrum	quantum
Planck's constant	photoelectric effect	photon
atomic emission spectrum	ground state	de Broglie equation
Heisenberg uncertainty principle	electron-dot structure	atomic orbital
principal quantum number	principle energy level	energy sublevel
electron configuration	aufbau principle	Pauli exclusion principle
Hund's rule	quantum mechanical model of the atom	valence electron

NAME:

Objectives

- **Compare** the wave and particle models of light.
- **Define** a quantum of energy and **explain** how it is related to an energy change of matter.
- **Contrast** continuous electromagnetic spectra and atomic emission spectra.
- **Compare** the Bohr and quantum mechanical models of the atom.
- **Explain** the impact of de Broglie's wave-particle duality and the Heisenberg uncertainty principle on the modern view of electrons in atoms.
- **Identify** the relationships among a hydrogen atom's energy levels, sublevels, and atomic orbitals.
- **Apply** the Pauli exclusion principle, the aufbau principle, and Hund's rule to write electron configurations using orbital diagrams and electron configuration notation.
- **Define** valence electrons and draw electron-dot structures representing an atom's valence electrons.

Short Answer and Problem-Solving

12. Use the information provided below to solve the following problems.

$c = 3.00\times10^{8}$ m/s	$h = 6.626\times10^{-34}$ Js	$E = h\nu$	$c = \lambda\nu$

a. What is the wavelength of light with a frequency of 1.00×10^{20} Hz?

$c = \lambda\nu \quad \lambda = \frac{c}{\nu} \quad \lambda = \frac{3.0\times10^{8}\ m/s}{1.00\times10^{20}/s} = 3\times10^{-12}\ m$ ↳ same as /s

b. What is the energy of a photon of light with a wavelength of 3.00×10^{-8} m?

$E = h\nu \quad c = \lambda\nu \quad \nu = \frac{c}{\lambda} \quad \frac{3.0\times10^{8}\ m/s}{3.0\times10^{-8}\ m} = 1\times10^{16}/s$

$E = 6.626\times10^{-34}\ Js \times 1\times10^{16}/s$

$E = 6.626\times10^{-18}\ J$

c. Which of the two waves in the questions above has greater energy (wave a or wave b)? Support your answer. You can demonstrate this with math or explain it in essay form.

The wave in A has the greatest Energy because energy and frequency are directly related

13. Use the periodic table to answer the following questions about arsenic.

a. Give the ground state electron configuration (long-hand notation).

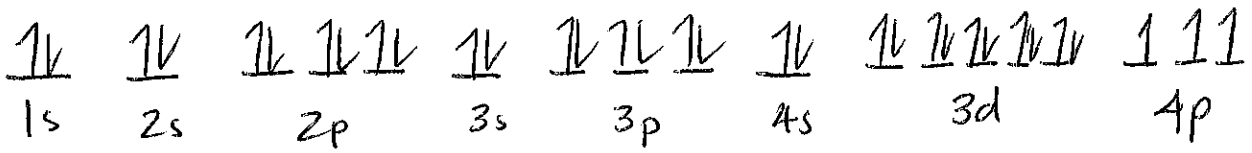
$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^3$

b. Write the electron configuration using noble gas notation.

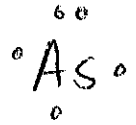
$[Ar]\ 4s^2 3d^{10} 4p^3$

NAME:

c. Draw its orbital diagram.



d. Illustrate its electron dot structure.



Unit 5 → The Periodic Table

Vocabulary

periodic law	group	period
representative element	transition element	metal
alkali metal	alkaline earth metal	transition metal
inner transition metal	nonmetal	halogen
noble gas	metalloid	ion
ionization energy	octet rule	electronegativity

Objectives

- **Trace** the development and identify key features of the periodic table.
- **Explain** why elements in the same group have similar properties.
- **Identify** the four blocks of the periodic table based on electron configuration.
- **Compare** period and group trends of several properties.
- **Relate** period and group trends in atomic radii to electron configuration.

Short Answer and Problem-Solving

14. Match the following descriptions with the correct corresponding elements. Write the letters of the answers on each blank line. Not every letter will be used.

G alkali metal in the 4th period
F transition metal that is liquid at room temperature
D halogen in the 2nd period
E noble gas with an electron configuration of $1s^2$
A alkaline earth metal in the 6th period
H 2 valence electrons in the 7th energy level

A – barium
B – bromine
C – chlorine
D – fluorine
E – helium
F – mercury
G – potassium
H – radium

15. Compare/contrast the electronegativity values of the following elements. Use the symbols >, <, or =.

H (>) Mg C (<) N F (>) I

would not expect you to compare elements in different periods + groups.